

## PHEASANTS AND FRITILLARIES: IS THERE REALLY ANY EVIDENCE THAT PHEASANT REARING MAY HAVE CAUSED BUTTERFLY DECLINES?

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### INTRODUCTION

Corke (1989) recently correlated the pattern of decline of certain butterflies with that of over-wintering pheasant density, and concluded that pheasants might be responsible for their declines. The main basis for his conclusion is that the decline of several species, as shown on published BRC maps (Heath, Pollard & Thomas, 1984), appears to be greater in SE Britain, and that this region coincides with the highest densities of reared pheasants. Unfortunately there is only circumstantial evidence on the subject and he has been extremely selective in his analysis. He has also overlooked several crucial facts about the ecology and behaviour of both pheasants and woodland butterflies. His conclusions are therefore misleading for the following reasons.

### PHEASANT ECOLOGY AND DIET

The ecology and rearing of pheasants has been thoroughly studied (see review by Hill & Robertson, 1988) and does not support Corke's hypothesis. Intensively reared pheasants are released between July and August and are at their highest density from then until the shooting season starts in October. The majority are then shot during the winter so that their breeding density the following spring is not greatly increased (never more than doubled) above the normal density expected for wild breeding birds. During the spring, the density is largely determined by the suitability of the habitat and is only slightly influenced by the numbers released the previous year. Male pheasants then set up their breeding territories in February (the end of the shooting season) and are joined in March by the females. Territories are nearly always established within 50 m of woodland edges, usually where thin borders fields with low vegetation where the males can display prominently. Another relevant fact is that various studies on pheasant diet during the winter (ie September–April) have shown that the vast majority of their food consists of grasses, leaves and roots. Only a small proportion (usually about 2% though this can rise to 10%) comprises animal food, including insects. Most of their foraging is carried out at ground level, up to a maximum height of 1 m, where they scavenge among the vegetation and visually search for food items. In a study on Brownsea Island in Dorset, the bulk of their insect prey was ants and beetles and, in an earlier British study, earthworms accounted for most of their animal diet. The diet of young pheasants is broadly similar, with only a small proportion comprising animal food. All feeding is carried out during daylight hours, with peaks of activity just after dawn and before dusk.

This means that only ground breeding species of butterfly are likely to be selected as food. Also, the main period of possible risk of predation by the release of *reared* pheasants is in the Autumn between August and October. Furthermore, the only species at risk are those which occur as large larvae at this time of year; those with small larvae will almost certainly be ignored by foraging pheasants. In common with most birds, pheasants probably optimize their foraging by selecting larger prey items

Martin Warren is a conservation consultant. This paper is in reply to David Corke's article (1989) which Dr Corke will further discuss in a lecture to the Society to be held on 14 December 1989.

unless they are conspicuous and highly abundant such as ants (eg Krebs & McCleery, 1984). Unfortunately, this does not seem to have been examined for pheasants, apart from a study on 2-week-old pheasant chicks which showed that they ignored insects less than 3 mm in size and preferentially selected insects larger than 6 mm (Whitmore, 1982). It therefore seems reasonable to assume that adults will select even larger prey, probably over 1 cm.

Additional support for the selection of larger insects by pheasants is provided by numerous life table studies on the Lepidoptera which have consistently shown that the main predators of the earlier, smaller instars are invertebrates. Birds and other vertebrates tend to restrict their predation to the later and larger instars (see review by Dempster, 1983). The chief possible risk for butterflies which only occur as large larvae in the spring will therefore be from *breeding* pheasants. However, as these will be concentrated near the wood edges during the spring, few woodland butterflies will be at risk as most colonies breed within the interior of woods, generally in rides, glades, or young plantations.

#### THE ASSESSMENT OF RISK TO BUTTERFLY LARVAE FROM PHEASANT PREDATION

In the light of these facts, we can now make an objective re-examination of Corke's assessment of the degree of risk from pheasant predation of Britain's declining butterflies. The assessment that he uses in his Table 4 seems inaccurate for many species, yet it is fundamental to his analysis. It is surely more realistic to say that if a species rarely or never breeds within woodland, or along wood edges, then it is not at risk, regardless of its other attributes. Thus the silver-spotted skipper, small blue, silver-studded blue and adonis blue, are at no risk whatsoever. The brown hairstreak breeds mainly in hedgerows, although adults usually congregate on a wood edge for mating, and is thus unlikely to be at risk (Thomas, 1974). Similarly, only a tiny proportion of marsh fritillary colonies have ever bred in woodlands (and these probably never persisted for long), as have only a very small proportion of dark green fritillary and marbled white colonies, so the overall risk to these species is again small. I agree with the assessment that the white admiral, purple emperor, and large tortoiseshell are not at risk as they all breed well above ground and out of reach of foraging pheasants (eg Pollard, 1979 and Willmott, 1987). However, on this basis, the wood white is also at low risk because its larvae feed high up on their vetch foodplants, usually 50–150 cm above ground (Warren, 1981, 1984). The larvae of the brown hairstreak also usually feed above 1 m and are consequently out of reach even where their breeding habitats do occasionally coincide with pheasant foraging areas (Thomas, 1974). Moreover, a thorough 7-year study of this species in an area of woodland that was devoted to pheasant rearing showed no evidence whatsoever for pheasant predation: willow warblers and small passerines predominantly ate the larger larvae on bushes, and small mammals the ground-living pupae (Thomas, 1974, and unpublished data).

The next point to examine for those species that do regularly breed in woodland is the size of the larvae during the main period of risk from reared pheasants, which is between August and October. At this time of year the larvae of the pearl-bordered, small pearl-bordered, and heath fritillaries are all very small and hibernate in their third or fourth instar, less than 1 cm long (Brooks & Knight, 1982). The high brown fritillary over-winters as an egg and the silver-washed and dark green fritillary as newly-hatched larvae (about 2 mm long). The silver-washed fritillary larvae will also be unavailable as they hibernate in grooves in tree trunks, usually 1.5–3 m above ground level (J. A. Thomas, pers. comm.). Thus, these fritillaries are unlikely to be

at any great risk from predation by the over-wintering pheasants that Corke has considered in his correlations. Their larvae do not become large enough to be considered as potential pheasant prey until the spring, by which time most reared pheasants have been shot and those that are left will be breeding around the wood edges. Even where breeding areas of pheasants and fritillaries do coincide, species such as the small pearl-bordered, high brown, and silver washed fritillary are probably at only a small risk due to the behaviour of their larvae. These spend nearly all their time resting under dead leaves or other vegetation and only emerge for brief bouts of feeding. The only fritillaries at some potential risk in the spring are the heath and pearl-bordered whose larvae spend long periods basking in the sun and are relatively conspicuous. However, for reasons explained above, it is unusual for their breeding areas to overlap greatly with those of pheasants. If there is any direct effect of reared pheasants on fritillaries, it is more likely to be due to the consumption of their food-plants. The effect of intensive pheasant rearing on the woodland ground flora has been shown to be detectable only within and immediately outside the release pens (within about 15 m, Ludolph, Payne & Robertson, 1989).

The only ground-dwelling woodland butterflies that have declined substantially and whose larvae are large enough to be potential prey for reared pheasants during the autumn are the chequered skipper, wood white, and Duke of Burgundy. The larvae of the former spin together the leaves of their grass foodplants into a tube, within which they spend most of their time (Brooks & Knight, 1982). They are probably at minimal risk, apart from the brief period when they move from one shelter to another. Similarly the Duke of Burgundy caterpillars are at minimal risk for most of their lives because they are nocturnal and rest during the day concealed close to the ground at the base of thick vegetation. However, they also feed during the day during their final instar, often on the tops of leaves (Butterflies Under Threat Team 1986), and may be vulnerable during this comparatively short period. The wood white may be at some risk, but, as mentioned above, most larvae will be out of reach. It is worth noting that one of the largest British populations of this species (which I have studied for many years, eg Warren, 1984) is at Yardley Chase, Northamptonshire, where pheasants were reared intensively and were often abundant in the same rides where wood whites were breeding. I only spent about 10 hours in hides observing potential bird predators, but never once saw a pheasant come close to one of the numerous wood white larvae.

My conclusion is therefore that the correlations identified by Corke are very unlikely to be the product of a causal relationship with pheasant predation. If such predation does occur, it is likely to be on a very local scale and where palatable larvae are present at a high density alongside pheasants. Such populations should be able to withstand any extra predation by pheasants. Pheasant predation could be expected to have a serious effect on butterfly colonies only if these were already small, if the larvae of the species are particularly vulnerable (and few of the declining species considered are), and if the main breeding areas were either immediately adjacent to the main pheasant release pens or close to woodland edges which were particularly suitable for breeding birds. Pheasant predation is therefore likely to be small for most of the rapidly declining woodland butterflies (and probably also small for the commoner species not discussed here) and could hardly affect the distribution of numerous species in the manner suggested by Corke. It is also relevant to note that butterfly losses in the Netherlands, including most of the woodland fritillaries, have been even greater than in Britain (Geraedts, 1986). However, few pheasants are reared there and releases are restricted by law to one bird per hectare of suitable cover. Clearly, there must be other factors responsible for the particularly severe decline of butterflies in some areas.

#### DATA AVAILABLE ON LARVAL PREDATION BY PHEASANTS

The only direct study of pheasant predation on butterfly larvae, not mentioned by Corke, is that of Porter (1981) who analysed the droppings of pheasants for remains of insect larvae, particularly the marsh fritillary. His study site was in a rough field adjacent to a wood where reared pheasants were regularly released, and foraged during the spring in the marsh fritillary breeding area. He analysed 150 pheasant droppings, and looked for larval remains such as spines or head capsules which would not be fully digested. He found signs of larvae in just two droppings (and there was some doubt as to the identification of these remains) and concluded that pheasants were a negligible cause of larval death and had little impact on the population, particularly when compared to the high mortalities caused by parasites. In another trial, I have fed full-grown larvae of the heath fritillary and marsh fritillary to young chickens, which, although not exactly the same as pheasants, are similar enough to act as a model. Larvae of the heath fritillary were consumed without any obvious ill-effects, but those of the marsh fritillary were picked up and immediately spat out again (Warren, 1985). A further observation of this is in captive blue-tits which only picked warily at marsh fritillary larvae, with much bill-wiping, a typical indication of distastefulness (K. Porter, unpublished data). I conclude that heath fritillary larvae are palatable but marsh fritillaries are far less so, perhaps due to the greater number and sharpness of the larval spines. The evidence therefore suggests that pheasants may find the larvae of some fritillaries edible, but there is considerable variation in the palatability of different species.

#### THE HEATH FRITILLARY AND PHEASANTS

Apart from his correlations, the only evidence presented by Corke are three old references to local extinctions of the heath fritillary, reputedly as a result of game rearing. These amount to single sentences in the literature and are purely anecdotal or conjecture. None of the authors present evidence to back their supposition, and one cannot help but infer that they, along with many other naturalists, were strongly biased against game rearing, often because it meant restrictions on their access to good localities. In my 10 years of detailed study of the heath fritillary, I have come across no direct evidence that the larvae are particularly at risk from pheasant predation. On the contrary, the three colonies that were close to pheasant rearing areas in Kent have thrived for many years. I remain convinced that the main cause of the decline of this species is the massive change in the suitability of its woodland habitats, particularly the decline in coppicing (Warren, 1987). There are many examples of this factor causing the extinction of heath fritillary colonies, such as the loss at Belfairs Nature Reserve in Essex during the 1960s (Down, 1989).

#### PHEASANT MANAGEMENT ON IMPORTANT BUTTERFLY SITES

My last piece of evidence on the subject is again circumstantial, but highly relevant to the debate. In a review of butterfly conservation in central southern England that I have just completed for the Nature Conservancy Council, I have compiled a list of 308 important butterfly localities, including 153 woodlands. Detailed surveys were conducted on all these sites, including assessments of the population size and precise breeding areas of 28 key species (ie all those declining or rare species). Out of the 39 woodland sites that were graded A or B (ie that were the most important for the rarer species, particularly the woodland fritillaries) at least 26 (67%) had been used

for intensive pheasant rearing or had specifically been managed for pheasants for many years. Particularly relevant are the data for the 29 pearl-bordered fritillary colonies, which is probably the species most at risk due to its larval behaviour. Over two-thirds of these were in woods with intensive pheasant rearing and in several cases the main breeding areas were in clearings immediately next to the main rearing pens.

Although this does not prove that pheasants never predate the larvae of some butterflies, it shows that they can co-exist, provided the habitat conditions are suitable. Clearly, it does not prove whether pheasant predation might tip the balance in less favourable habitats where pheasant numbers are exceptionally high at the critical time of year. However, in these circumstances, butterflies will exist as small populations which will be prone to chance extinctions due to other ecological factors, notably weather variations (eg Pollard, 1988). The results of the above review may even suggest the reverse of the hypothesis suggested by Corke: that management for pheasants can be beneficial to butterflies. Some species, including the fritillaries, regularly occurred at high densities in areas where pheasants were abundant. Also, a slightly greater proportion (67%) of good butterfly woods were managed for game than is the average for woods in central southern England (thought to be about 50%).

#### THE PATTERNS OF BUTTERFLY DECLINES AND THEIR CAUSES

If pheasants are not to blame, then what are the likeliest causes of Corke's correlations? To start with, correlations do not demonstrate causal relationships and there are serious doubts about the validity of using the BRC data for a statistical comparison of the rate of decline in different regions. As Corke points out, the interpretation of such data is difficult due to the distribution of recorders etc. For example, there is almost certainly a bias due to greater recording in SE England, particularly for the earlier historical records (eg Dennis & Williams, 1986). If butterfly declines were spread evenly over the whole country, this bias could result in them showing up worst in the south-east. Even if we assume that some butterfly declines have indeed been more serious in SE England, as the present evidence suggests, there are many factors other than pheasants that might be responsible. Barbour (1986) has analysed the butterfly distribution data in a similar way and has shown that the region with most declines coincides with lichen depletion zones, thereby implicating air pollution. However, as in Corke's study, no direct evidence is presented and a causal relationship is far from proven. It is perhaps surprising that no-one has examined far more plausible factors such as hedgerow removal or agricultural intensification which have also been most severe in SE England. Similar correlations would undoubtedly be found by comparing butterfly declines with the proportion of steep, unploughable land, which is far greater away from the SE, or with grade one and two agricultural land which is concentrated in the SE.

As far as the woodland fritillaries are concerned, there is a far simpler explanation for the pattern of their decline. Virtually all these species have always been confined to woodland habitats in SE England, but as you go further west, and for some species north, many colonies are found in more open habitats such as rough grassland. This has been well established for the heath fritillary in the west country (Warren, Thomas & Thomas, 1984) and by examination of the BRC records for the high brown, pearl-bordered, and small pearl-bordered fritillaries (Heath *et al.*, 1984). To give just two examples, the latter two species are quite abundant in the rough grasslands of the north Cornish coast, and in open grassland and moorland in Scotland (Thomson, 1980). Such habitats do not occur in much of central southern

and south-east Britain where these species have always been confined to woodland clearings. In the past, such clearings were created regularly by the traditional management of coppicing whereby portions of each wood were cut on rotation. However, during the 19th century, this form of management declined and is now practised in only 2% of British woods. Most modern woods are simply too shaded for these and several other woodland butterflies, and lack the continuity of regular clearances. It is worth noting that the woodland fritillaries have died out on many nature reserves where there has been no pheasant rearing but often a period of little or no management (eg Thomas, 1984). Nearly all the remaining coppice (largely sweet chestnut) is in Kent and E Sussex, and contains the last few populations of the heath and pearl-bordered fritillaries in the south-east. Throughout most of Britain, coppicing has ceased entirely and the woodland fritillaries have been increasingly confined to areas of the country where alternative types of habitat are available. For geological and climatic reasons, these happen to be concentrated in the south-west and in the north.

#### CONCLUSIONS

The evidence available suggests that, given the correct habitat management, woodland butterflies can withstand any possible minor increase in predation that might be associated with pheasant rearing. My main conclusion, therefore, is that entomologists with an interest in conservation should concentrate on ensuring that habitats are managed in a suitable way for butterflies. At a time when most woods contain few open areas and early successional stages where many of our woodland butterflies can breed, it is in the butterflies' interest to encourage any management that might lead to the creation of sunny rides or clearings. In this context, the management of woodlands for game may well be a positive benefit to butterflies and other wildlife, although the precise form of that management is likely to be crucial (eg Warren & Fuller in press). In addition to the data presented above, Robertson, Woodburn & Hill (1988) have shown that a greater abundance and more species of butterflies were found in areas of woodland that were managed for pheasants. However, there are still major problems to overcome before management for game can be fully integrated with good nature conservation, such as the practice of spreading straw on the rides in pheasant feeding areas, and the control of predatory wildlife. Also, much better information is needed on the management of woodland, particularly the rides and glades, for the benefit of both wildlife and game interests. In short, there are many more positive research areas in which to place scarce resources than into the examination of any impact of pheasant predation on butterfly larvae.

#### ACKNOWLEDGEMENTS

I would like to thank Drs R.L.H. Dennis, R.J. Fuller, I.F.G. McLean, K. Porter and J.A. Thomas for their discussion of the topic and comments on the manuscript. The review of butterfly conservation in central southern England was commissioned by the Nature Conservancy Council as part of its programme of research into nature conservation.

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